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Network Innovation Competition Screening Submission Pro forma

Notes on completion

Before completing this form, please refer to the relevant Network Innovation Competition (NIC) Governance Document(s).[1]

Please use default font (Verdana size 10) in your submission and retain 1.5 line spacing.

We will only accept the text visible in the text entry areas.

The text entry areas are predetermined and should not be changed.

The full-completed submission should not exceed 19 pages in total.

Ofgem will publish all the information contained within this Screening Submission.

Is the application for the Gas or Electricity NIC? If a Cross-Industry Project, please state 'Cross-Industry'.
Electricity NIC
Funding Licensee
National Grid Electricity Transmission
Project Partners including other Licensees
We will use a competitive procurement route to appoint a supplier and actively engage with licensees and stakeholders.
Project Title
Project Retro-ICAs (RICA)

[1] https://www.ofgem.gov.uk/publications-and-updates/version-30-network-innovation-competition-governance-documents All capitalised terms used in this document have the meaning given to them in the respective NIC Governance Document.

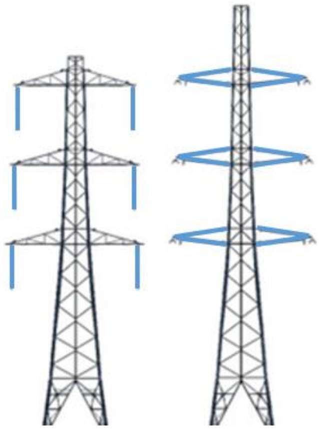
Project Summary			
The UK's ambitious target of delivering net zero carbon emissions by 2050 must be met to ensure the longevity of our society, but it comes with challenges to both industry and consumers. Given the expected increases in renewable generation and the electrification of transport and heat, demands on the network are likely to increase. Finding innovative ways to develop network infrastructure at minimum credible cost will deliver better value for money to consumers and accelerate our low carbon future. This project will develop a novel method of uprating Overhead Lines (OHLs), aimed at accelerating our low carbon future by allowing quicker connection of renewable generation, while also delivering on other stakeholder values. Insulated Cross-Arms (ICAs) replace the standard metallic cross-arms from which insulators and conductors are suspended. Retrofitted ICAs (RICAs) would allow licensees to upgrade the voltage rating on their existing towers, e.g. converting 275kV towers for 400kV, and open the door to Ultra High Voltage (UHV) networks in the UK. RICAs provide major savings in time and cost and use fewer materials. Wider benefits to stakeholders include reduced construction volumes and timescales, reduced community impact, and improved visual and environmental impact of network investments. This project will provide a pathway for the world's first full-scale implementation of RICA technology, by filling the existing knowledge gaps and accelerating its adoption onto a transmission investment scheme.			
Estimated Start Date		**Estimated End Date**	
Q1 2021		Q4 2024	
Total Project Cost	£11.2m	**NIC Funding requested**	£10.1m
Technology Readiness Level (TRL) at start and end of project			TRL7 – TRL9

What is the Problem that the Project seeks to address?
The move towards renewable generation necessary to achieve the UK government's Net-Zero emissions target is having an increasingly significant effect on transmission network constraints. More renewable generation will connect to the transmission system to replace existing, carbon-intensive generation, particularly in remote and offshore areas. In addition, there is a predicted increase in peak demand due to the electrification of heat and transport, particularly in urban areas. While some of this demand is offset by local generation, network modelling shows there will be significant changes to power flows across the transmission system, leading to constraints and required network reinforcement. Although new interconnectors will help to address some of these constraints, reinforcement of the GB network will also be required. This requirement will be particularly felt at key transmission boundaries including the critical North-South links. Reinforcement can be achieved through new or uprated OHLs. However, all existing options are currently challenging either from a cost or time-to-deliver perspective. New OHLs are expensive, require significant stakeholder engagement to manage customer, consumer, and environmental impact, and often require lengthy land acquisition and consenting applications. We must balance the need for new OHLs with our commitment to conserving and enhancing the natural beauty, wildlife and cultural heritage of the landscape. Present options for increasing power transfer capacity include reconductoring, installing additional conductors, increasing voltage levels or controlling power flows. On older OHLs, reconductoring can increase capacity to an extent. For further capacity increases, additional conductors can be installed, often requiring tower reinforcement due to increased mechanical loading. Uprating the voltage of OHLs currently requires new, taller towers to meet minimum clearances to ground, creating similar challenges as for new OHLs. This project seeks to enable deployment of RICA technology at transmission voltages by using it to uprate an existing 275kV route to 400kV; providing valuable grid reconfiguration. This project will build on previous research and development to take the technology to the point where it becomes BAU. If the challenges outlined in the following sections can be met by the project, this would also open the door to UHV transmission in the UK.

What Method(s) will be used and why? Ie, what is being demonstrated or developed? Please describe in terms of the NIC eligibility criteria. (page 1/3)

What is 'RICA'?

The Retrofit ICA (RICA) is an arrangement of electrical insulators to replace steel cross-arms and suspended vertical insulator strings on transmission towers; which can be installed on an existing tower. It enables conductors to be attached directly to the cross-arm, increasing clearances, allowing higher voltages to be used.



Before: 275 kV Tower **After: RICA 400 kV Tower**

Project Objectives

During this project, NGET will work with a supplier to meet the following objectives:

- Demonstrate an alternative investment option to prevent the need for new or replacement of existing circuits;
- Finalise the range of designs for RICAs and associated tower modifications, undertake technical assurance, working with a supplier; and
- Scale up the technology to deliver the RICA method on an operational route, delivering an investment that is preferable for stakeholders.

Project Approach

This project is split into four workstreams: Preliminary Works, Development, Scheme Delivery, and Stakeholder Engagement. Project gates will be applied at key stages.

1. *Preliminary Works*

Working closely with a supplier, functional specifications will be developed for the RICAs, and optimal configurations will be established. This will require surveys to be performed of the route proposed for Workstream 3 (Delivery), to cover steelwork, electrical clearance, and foundations; any local environmental considerations will also be captured. Assessment of tower and ICA loading requirements and electrical design calculations will be carried out for different RICA options.

A detailed review will also take place to understand how broadly this technology can be replicated across different tower types, enabling RICA to be deployed across the GB network. This will include consultation with other licensees and stakeholders.

What Method(s) will be used and why? (page 2/3)
We will form a project advisory board, to ensure robust project governance and to communicate progress effectively to all stakeholders. The following key questions will be answered before the project moves into Workstream 2: • What improvement on time for upgrades can be delivered against new build? • Are there any unintended consequences to deploying the technology? • What capacity increase is achievable using the technology? Key outputs for this stage: 1) a fully developed investment option, 2) functional specification of the RICAs, and 3) detailed risk register and suitable mitigations. 2. *Development* This complex stage ensures the designs for multiple configurations on an entire route can all be deployed cost-effectively, safely, and efficiently. The cross-arm design options will first be modelled in CAD and critically assessed against the requirements. The tooling for the chosen ICA designs will then be manufactured and prototypes will be made and subjected to the required electrical and mechanical tests. NGET will refine the techniques and procedures for installation and maintenance; taking into account the lessons learned from previous trials. This will seek to reduce the operational costs of RICAs, improving whole-life costs for consumers. The learning generated here can be adopted into the design and functional specifications of the RICAs, which can be shared with and applied by all licensees. A long-term monitoring system will also be developed and tested, which will be used to collect condition data over an extended period on RICAs. This data will be used to accelerate the long-term adoption of this technology, accelerating the project's benefits. All measurement data will be published and disseminated through publications and events. Key outputs for this stage: 1) full suite of designed and tested RICAs, 2) detailed installation specifications, 3) detailed whole-life guidance, and 4) monitoring system design. 3. *Scheme Delivery (on an operational route)* The final RICA designs will be produced and installed. As this point the majority of the costs will fall under BAU, although the NIC team will continue to engage and support the project.

What Method(s) will be used and why? (3/3)
Engineering activities will be required to support the installation and testing of the monitoring systems including some preliminary data analysis to ensure the systems are recording data. Other main activities will be to engage with the wider business, stakeholders, and adopt lessons learnt from delivery. <u>Key outputs for this stage: 1) type registration of each of the ICAs, 2) installation of cross-arms including necessary tower modifications, and 3) working data capture systems.</u> *4. Stakeholder Engagement* An engagement and communication strategy will be developed at the start of the project and maintained throughout, especially with local communities. However, a concentrated knowledge sharing stage following the demonstration will be key to ensuring the technology transitions successfully to BAU rollout. <u>Key outputs: 1) workshops with transmission licensees and other key stakeholders (e.g. environmental), and 2) industrial publications to disseminate data and knowledge.</u>

Funding Commentary (page 1/2) *Licensee must provide a commentary on the accuracy of its funding estimate. If the Project has phases, the Licensee must identify the approximate cost of each phase. If the NIC is being used as match funding, please state the other sources of funding.*

The NIC funding is being requested to cover the costs incurred from developing RICAs to the point where they can be delivered in a transmission scheme. The application on an actual route will be BAU funded. The following preliminary costs are given to approximately +/- 20% accuracy for each stage of the NIC project:

Item	Cost(£m)
Workstream 1 – Preliminary Works	£2.0
Workstream 2 – Development	£8.2
Workstream 3 – Scheme Delivery	£0.6
Workstream 4 – Stakeholder Engagement	£0.4
Total:	**£11.2**

Of the £11.2m estimated cost, NGET would contribute 10% and request the remaining 90% through NIC funding.

Funding Commentary (page 2/2)
Until RICA technology is proven by the Project, a viable BAU option for scheme delivery will necessarily be progressed alongside, to mitigate the risk to the business and to the transmission system of not being able to make key reinforcements in a timely manner. The NIC project comprises all costs associated with the additional innovation activities required to bring a supplier to the point where they would be confident in accepting the risks from delivering the proposed scheme. Cost estimates are based upon existing unit costs, people costs based on current rates and estimated work using costs for ICAs from our previous NIA project covering design and prototype of ICAs for L3 suspension towers, and preliminary stakeholder engagement. The NGET funds will be focused on the development of the project and the NIC funds will be more focused on the design and testing of the hardware and equipment. Type registration costs will be covered under the Totex Mechanism. No additional funding sources are currently planned, but NGET will seek further support from other licensees as part of the full submission. **Processes to reduce Project costs** Gates between each of the NIC project workstreams defined earlier, and sub-gates within the development workstream, will be used to assess the driver to continue and assess if RICAs can still be delivered in line with the scheme's delivery timeline. In the event a suitable project cannot be identified to allow the detailed comparative development required, or the cost benefit analysis is shown to be unfavourable, the project's board will review progress options, one of which would be to stop and return remaining funds to consumers. Our procurement process (detailed later) will ensure the best supplier in terms of cost and technical capability is identified; and require them to carry a share of the financial risk involved in innovation at the beginning of the project. Re-examining the costed project plan as the activities progress will ensure the project keeps on track financially. This will be necessary to achieve a key outcome of the project – to develop an alternative investment option to BAU.

Which specific requirements does the Project fulfill?		
Mark YES in the appropriate box(es)	**Electricity**	**Gas**
A specific piece of new (ie unproven in GB) equipment (including control and/or communications systems and/or software)	**YES**	
A specific novel arrangement or application of existing electricity/gas transmission and/or distribution equipment (including control and communications systems software)		
A specific novel operational practice directly related to the operation of the electricity/gas transmission and/or distribution systems		
A specific novel commercial arrangement		

How does the Project accelerate the development of a low carbon energy sector and have the potential to deliver net financial benefits to existing and/or future customers in the relevant sector? (page 1/2)

Achieving the Carbon Plan and delivering financial benefit

In the problem statement, we described that additional transmission system constraints will arise due to the Net Zero transition, as more renewable generation is installed to meet an increase in demand in densely populated areas. For example, the NGESO 2019 Electricity Ten Year Statement (ETYS) shows that as wind power in Scotland grows, the flows across all boundaries north of the Midlands (England) are set to double to meet demand arising in the Midlands (England) and in the London area.

As recognised in the NGESO 2019 Network Options Assessment (NOA), thermal constraints are the most common constraints, which can be alleviated with the following actions: *1. Upgrade existing circuits through conductor replacement or increased operating voltage, 2. Develop new circuits, 3. Build new substations, usually to optimise the flows on a pair of OHL circuits, 4. Control power flow with compensating technologies.*

RICAs reduce the cost and therefore remove some of the financial risks associated with longer term network reinforcement – meaning significant reinforcement becomes

Accelerates the low carbon energy sector (page 2/2)
a 'least regrets' option. This accelerates the connection of low-cost, low-carbon generation. In this regard, this project addresses several aspects of the Carbon Plan involved with facilitating the connection of low carbon generation through capacity increases and facilitating the demand increase for heating and transport in the regions that need it most. *Further environmental benefits – including reduced visual impact and ecological benefits – are discussed in the impact on customers question below.* **The contribution of this method to the Carbon Plan** Assuming that the additional line capacity is approximately equal to the additional headroom required for low carbon generation, RICA implementation at the proposed trial site could release up to 2GW additional capacity for renewable generation, unlocking the potential for significant Greenhouse Gas savings compared to current BAU options (This approximation is both optimistic in the sense that not all capacity might be used and there might be constraints on neighbouring circuits, and conservative in that much of the generation might be used locally). Applying the same assumptions as for the cost analysis (assuming our trial site represents ~10% of all suitable RICA locations) this project could facilitate the early connection of over 20GW of renewable generation. The project also opens the door for future operation beyond 400kV, exploring the use of RICA solutions to carry higher voltage lines on existing 400kV towers. Furthermore, operating at higher voltages also contributes a small but important reduction to active power losses, and to associated monetary and carbon costs. There will be a reduced need for new steelwork compared with new build (and possibly traditionally reinforced OHL towers), helping to deliver investments with a low cost of carbon. **Deliver solutions more quickly than current methods** Crucially to the low-carbon transition, there is the possibility of accelerating project timescales from need identification to implementation compared to current reinforcement options. We anticipate that the reduced complexity around mechanical upgrades (as an uprating alternative) and reduced planning consents (as a new build alternative) could save significant time during the scheme's delivery, the exact amount of time saved will be a key learning from this project.

How will the Project deliver value for money for electricity and/or gas customers?
The use of RICAs will support the UK government's legislated net-zero carbon 2050 target while helping to maintain security of supply through increasing capacity of critical 275kV networks at minimum cost and disruption to customer and consumers. The direct impact of the project is realised in the short to medium term, as the implementation of RICAs on a live operational route will realise improved flows over key transmission boundaries. The right investment decision in any instance will require ongoing collaboration with NGESO as the energy system evolves. However, we have a great deal of confidence, based on cost benefit analyses for a proposed route, that – if the RICA option were available – its overall Net Present Value (NPV) to consumers compared to alternative reinforcement options significantly outweighs the cost of this project. In the longer term, this project will unlock further value as the RICA solution is rolled out across GB. Of the circa 22,000 towers in the NGET network, approximately 20% of these carry 275kV OHLs. Out of these, we estimate a further 20-25% could use a RICA solution to increase capacity. We believe the benefits of this project could be replicated a minimum of ten-fold in the NGET area alone. RICA would also allow network reconfiguration to occur more easily and without the need for entirely new routes to be built. This will allow existing assets used to feed demand centres to be better utilised to reconfigure the network; leveraging the existing asset base to deliver better overall transmission capacity. The ability to reconfigure the network more easily also opens the door to considering UHV networks for critical UK boundaries, establishing a pathway for large long term benefits to consumers. In addition to the direct positive impacts to decarbonisation and security of supply, additional value will be a lower visual impact, easier project consents and faster delivery of network projects; particularly for 275kV circuits which surround major demand centres (e.g. Midlands and the London area). Lower capacity uplift costs will be realised due to these shorter duration projects with less onerous planning activities and reduction of the need for high capital cost, larger towers. Furthermore, there will be reduced system constraint costs due to curtailment of renewable generation and disconnection of demand during system events.

How will the Project generate knowledge that can be shared amongst all relevant Network Licensees?
This project will expand the previous innovations for ICAs to full scale deployment on an OHL route with a suite of solutions for multiple tower families, a method that will be directly replicable by the other Transmission Owners. This project will specifically help to develop a suite of RICAs and associated guidance that will enable the regular and reliable application of the methodology across the transmission network. Notably: • The details on how to specify the appropriate RICA designs and the requirements of each, which can be used and amended by licensees to form their own specifications. • Guidance on optimal conductor types/configurations to maximise increases in capacity. • Knowledge on the methods of installation will be disseminated. This will include safe methods of working, outage requirements, and site management considerations. • Guidance around the maintenance of the RICAs and the modified assets. This will include how to perform new and existing practices within NG's safety rules. • Learning from the consents process will also be generated, demonstrating to all Licensees how this part of project delivery can be accelerated. This will include details on how these investments are perceived by local stakeholders and any additional impacts that should be considered during this type of investment. The project will demonstrate how RICAs enable faster customer connections; as network re-enforcements can be delivered in a shorter period of time. The new set of project costs and timescales will be communicated with NGESO, who may wish to feed this back into the cost-benefit analysis for the NOA. This knowledge on alternative network reinforcements can help all licensees consider a broader range of more sustainable solutions at different voltage levels, relevant to DNOs at lower voltage levels, and also enabling further innovations that may seek to facilitate Ultra High Voltage (UHV) investments. Project communications and engagement will be regular through a variety of channels, both face-to-face and digital to ensure two-way communication.

Answering Yes or No, does the Project conform to the default Intellectual Property Rights (IPR) arrangements set out in the NIC Governance Document? *If answer is NO, the Licensee must demonstrate how learning will be disseminated to other relevant Licensees and how value for money will be ensured. The Licensee must also outline the proposed alternative arrangements and justify why the arrangements are more suitable than the default IPR arrangements.*
Yes. We will clearly articulate the default IPR position to third parties as part of our procurement process. We do not anticipate needing to deviate from the default IPR position. However, should we find that through our tender process there are specific instances or elements where we need to deviate from the standard IPR position; we will consult with Ofgem directly to understand if this is acceptable.

How does the project demonstrate it is innovative (ie not business as usual) and has an unproven business case, that the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness?
This project will build upon previous research and development, taking the under developed RICA technology to the point where it can be applied to an entire existing route. The plans for Net Zero transition have heightened the need for future onshore network reinforcement in more recent years, and this has spurred on the development of RICAs for use as BAU. The technology has been developed to TRL7 for the L3 suspension towers, and this presents a good starting point for design and development for the cross arms to fit other tower types, namely L66 towers in suspension, as well as L3/L66 towers in angle and terminal configurations, which are still at TRL6. In all instances, extensive structural loading assessments are still required. This NIC development, followed by appropriate verification of the final design, will develop and verify technology and integration methods that cannot be justified as BAU. Furthermore, there is value in reviewing design options with the manufacturers to identify further improvements. e.g. the potential for the utilisation of new materials such as thermoplastics. The technology is unproven for BAU to the extent that we would not be able to find a supplier willing to accept the risk associated with it. *Previous Innovation Projects:* We have extensively reviewed previous UK transmission projects that have developed the technology to date and will directly build upon these. Projects include: Insulated Cross-Arms – Lecht & St Fergus Trials (NIA_SHET_0006), Insulated Cross-Arms – 132kV Trials (NIA_SHET_0007) and our Composite Cross-Arms Study (NIA_NGET0024). It is also pertinent to be aware of SSE's NIC project New Suite of Transmission Structures (NeSTS) for the wider benefits case, although this project focuses on new build solutions as opposed to retrofit. These projects have identified a number of extant risks and several unknowns that must be closed out before NGET can deploy RICAs as BAU in its networks. These are presented in the 'Further Details' section below.

How were Project Partners, external resources/funding identified, and what are their respective roles in the Project? Please evidence how Partners were identified and selected, including the process and rationale that has been followed. *The Licensee should provide details of any Project Partners who will be actively involved in the Project and are prepared to devote time, resources and/or funding to the Project. If the Licensee has not identified any specific Project Partners, it should provide details of the type of Project Partners it wishes to attract to the Project.*
The project plan includes time to perform a clear and transparent tender to identify a suitable supplier for the design, manufacture, and installation of the equipment. The procurement methods we will use will follow the EU Public Procurement Directive and the Public Contracts Regulations. This will enable the best supplier in terms of cost and technical capability to be identified; ensuring that the consumer obtains value for money during the NIC project's delivery. We will encourage competition through a transparent pre-qualification stage. As the majority of the Scottish transmission network is operated at 275kV, we intend for SPT and SHETL to be key stakeholders in the project. Interest in the technology is demonstrated by trials undertaken by SSE previously. They will be invited to join the project's advisory board. Collaboration with NGESO will also be important to understanding the cost benefit analysis in the NOA, and how project learning is impacting the assessments of options to uprate OHLs, particularly including from 275kV to 400kV. This will ensure the learning delivered from the project is maximised such that all GB licensees will benefit.

Would the Project require any derogations or exemptions to current regulatory arrangements? *If YES, please provide details of the required changes.*
No

How will the Project activities impact customers? *The Licensee should outline any planned interaction with customers or customers' premises as part of the Project, and any other direct customer impact (eg amended charging arrangements, supply interruptions).*

A key benefit of the RICA, and a fundamental purpose of the project, is to minimise the impact on customers. Although land access for work on the towers will be required under any reinforcement option, the final solution avoids building taller towers traditionally used for 400kV lines. This would enable the voltage upgrading of circuits whilst minimising the disruption and visual impact to landowners.

Additionally, the disruption caused by the construction phase would be greatly reduced. This is also true when comparing to equivalent BAU network upgrades to existing towers, as the required structural work for tower strengthening would be less with the RICA due to reduced mechanical stresses. The development of a suitable outage programme for implementing the technology on a trial route is expected to be managed by BAU processes. In delivery of the technology's demonstration, we will undertake all tower reinforcement work possible without an outage, before moving on to the significant tower modifications.

The project will resolve and clarify the planning and permissioning arrangements required, and produce guidance, with a view to reducing the time and cost in the future. This guidance can be communicated with external stakeholders and customers.

Additionally, we must consider the potential environmental benefits, as the RICA method will lead to minimum disruption of 'virgin' land compared to new towers or replacement towers. Additional environmental benefits are also expected from the accelerated delivery of onshore reinforcement schemes, which will enable more renewable generation on the network sooner.

Furthermore, on an equivalent voltage basis, RICAs would provide a solution for mitigating high levels of electrical field / clearance in a particular area due to the increased height and smaller spacing between phases. Research suggests that for voltage upgrades, this cancels out the increased field associated with the higher voltages. These EMF considerations will be confirmed by the project. Previous projects have also indicated that ICAs reduce operational noise levels.

This question is for Cross-Industry Projects only. What funding is being requested from each NIC? Please include justification for the funding split.
N/A

Are there any further details the Licensee considers would support its submission?
We know from previous engagement, including as part of major projects consenting, that consumers in local communities are not supportive of the replacement of existing lines with larger towers, mainly from a visual amenity perspective. They are also negatively impacted by the disruption of construction works for as long as there is a presence on site. We see this project as an opportunity to deliver an Innovation that directly addresses concerns raised by stakeholders. However, there are still a number of extant risks and several unknowns that must be closed out before NGET can deploy RICAs as BAU in its networks. These include (but are not limited to): • Further development work is required to deploy ICAs in retrofit applications, particularly whilst accommodating bundled conductors. • A full assessment and design assurance is required for various mechanical/structural load conditions on tower types as yet unconsidered. • The appropriate methods of lightning shielding of the existing towers. • The planning considerations associated with RICAs, specifically with the voltage upgrade from 275kV to 400kV on existing routes. • Maintenance and refurbishment, and disposal strategies are unknown and previous projects have identified issues that need to be addressed. • Guidance also needs to be developed to support NGET major project planning and development. Unknown project aspects include outage strategies for retrofit installation, planning aspects with voltage uprating existing routes, changes to safety rules, security considerations, and the environmental mitigations required. We have interrogated a number of sources in the collation of this list, including the thesis and the close down reports for the Composite Cross-Arms Study, the ICA – Lecht & St Fergus Trials and the ICA – 132kV Trials NIA close down reports.

Contact Information (Cross-Industry Projects can provide two contacts)

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